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DISTRIBUTED ION SOURCE ACCELERATION COLUMN

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Abstract

This invention is a collection of electrodes which create an electrostatic potential appropriate to accelerate a distributed source ions initially at rest to energies of up to tens of kilo volts(k V). The device's novel characteristics are that it performs this acceleration without inducing either strong electrostatic lensing or a large energy spread in the source. It accomplishes these tasks while remaining compact when compared with designs used in current practice. Each of the device's features addresses one of the problems inherent in current practice designs. One such problem is the difficulty in accelerating a non-point like source of ions without inducing a large energy spread in the resultant beam. The larger the spatial extent of the source of ions, and the larger the electric field at the source, the greater will be the energy spread. This energy spread will result in a larger spot size when the beam is focused and thereby reduce its usefulness as a nano-scale probe. By maintaining a small electric field at the ion source, a small energy spread can be obtained. However, if ions are to be accelerated to a few kV, then either acceleration will have to occur over a long distance, or a stronger electric field will be needed along the beam away from the source. If acceleration is to occur over a long distance using conventional electrostatic electrodes made from good conductors, then the area of these electrodes will have to be on the order of the square of the distance separating them in order to ensure field uniformity. This would, in most cases, make the electrode structure impractically large. If, instead, the ions are accelerated over a smaller distance, then the beam will experience strong electrostatic lensing. If lensing induces the ions to come to a focus (a so-called 'cross-over') then inter-ion Coulomb forces will reduce the quality of the ion beam and again result in a larger spot size when the beam is re-focused. This invention's design addresses each of these problems encountered by currentpractice designs. The apparatus consists of three parts. The source of ions lies between two disk-shaped electrodes. The surfaces of these electrodes have a uniform potential applied across them. This potential, in turn, creates a uniform electric field which accelerates the ions towards one of the disks with a hole punched through it. After passing through the hole the ions enter a region enclosed by a long tube-shaped electrode. This electrode has a uniform resistive coating on its inner surface. This coating ensures a uniform electric field along the tube's length. The length of the tube is many times as large as the disk separation. By maintaining a small, uniform electric field over the entire length of the device a small energy spread in the source may be maintained and lensing is avoided. The use of a resistive element allows a uniform field to be created while keeping the electrode structure compact along the directions perpendicular to the beam's propagation.

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Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

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